Chapter 1

Introduction

1.1 The Need for Aviation System Capacity Improvement

In 1990, 23 airports each exceeded 20,000 hours of airline flight delays.[1] By 2000, the number of airports which could exceed 20,000 hours of annual aircraft delay is projected to grow from 23 to 40, unless capacity improvements are made. The purpose of this plan is to identify and facilitate actions that can be taken by both the public and private sectors to prevent the projected growth in delays. These actions include:

In 1990, 23 airports each exceeded 20,000 hours of airline flight delays. By 2000, the number of airports which could exceed 20,000 hours of annual aircraft delay is projected to grow from 23 to 40.

- Airport Development,
- Airspace Development and New Airspace Procedures,
- New Technology, and
- Marketplace Solutions.

While current forecasts project serious delays in the absence of capacity improvements, the message shown in the following pages is positive. For example, much is currently being done to improve the situation through new construction and Air Traffic Control (ATC) procedural enhancements. In addition, there are many emerging technologies in the surveillance, communications, and navigation areas that will further improve the efficiency of existing and new runways.

1. With an average airline operating cost of about $1,600 per hour of delay, this means that each of these 23 airports incurred a minimum of $32 million dollars of delay in 1990.

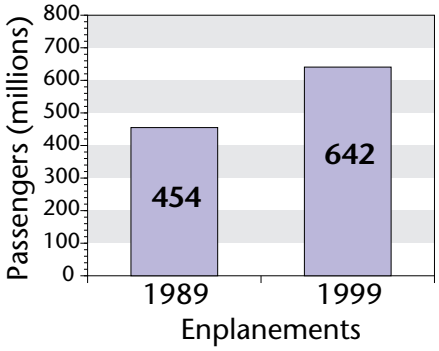
1.2 Level of Aviation Activity

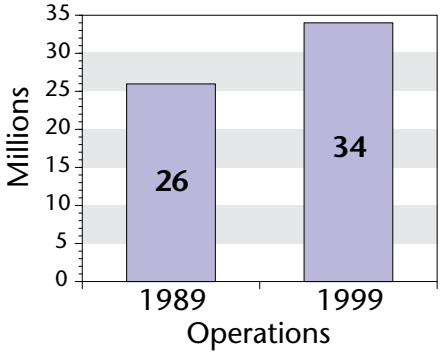
This plan concentrates on the top 100 airports in the U.S. as measured by 1989 enplanements, shown in Figure 1-1. The top 100 airports[2] account for 90% of the 454 million airline passengers who enplaned nationally in 1989.

In 1999, 642 million passengers are forecast to enplane at these airports.[3] This represents a projected growth in enplanements of 41% over the next 10 years.

In 1989, approximately 26 million aircraft operations occurred at these top 100 airports. By 1999, operations are forecast to grow to 34 million at the same 100 airports; a projected growth in operations of 31%.[4]

The top 100 airports account for 90% of 454 million airline passengers who enplaned nationally in 1989.





Aircraft operations increased from Fiscal Year 89 to FY90 at 77 airports.

1.2.1 Activity Statistics at Top 100 Airports

Of the top 100 airports, enplanements increased at 54 airports from Calendar Year (CY)88 to CY89, and decreased at 46.[5] Aircraft operations increased from Fiscal Year (FY)89 to FY90 at 77 airports.[6]

2. The top 100 airports were chosen based on CY89 passenger enplanement data as listed in *Airport Activity Statistics of Certificated Route Air Carriers*, 1989 enplanement data. A national map of the 100 airports is pictured in Figure 1-1, and recent operations and enplanement data are provided in Table A-1 of Appendix A.
3. Based on FAA's *Terminal Area Forecast*. Current enplanement data, a ten year forecast, and percentage growth that the forecast represents are shown in Table A-2 (Appendix A).
4. Table A-3 (Appendix A) shows 1989 aircraft operations, 1999 forecasts, and percent change by airport.
5. See Table A-4 (Appendix A) for a ranking by percentage growth in enplanements at the top 100 airports.
6. See Table A-5 (Appendix A) for a ranking by percentage growth in operations at the top 100 airports. Operations data were unavailable for Agana Field (NGM) in Guam.

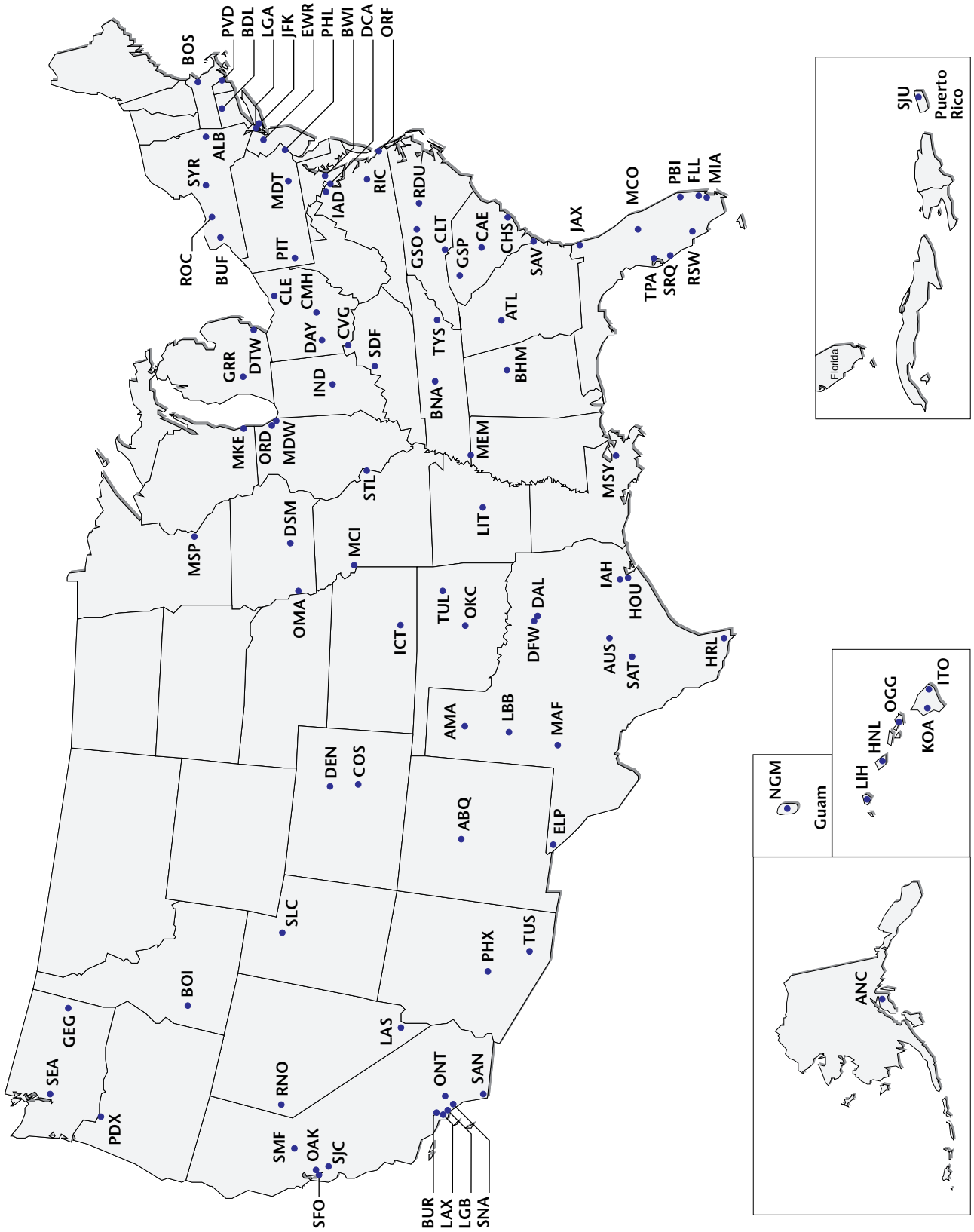


Figure 1-1. The Top 100 Airports by 1989 Enplanements.
Source: Airport Activity Statistics of Certificated Route Air Carriers, 1989

1.2.2 Traffic Volumes in the 20 Air Route Traffic Control Centers (ARTCCs)

ARTCC volume statistics for 1990 showed that Instrument Flight Rules (IFR) operations increased at 15 of the 20 Continental United States (CONUS) ARTCCs over 1989.[7]

In 1989, the number of aircraft flying under instrument rules handled by ARTCCs increased by 0.5% over 1988 to 36.6 million operations. Commercial aircraft handled at the centers decreased by 4.3%, compared with a decline of 5.9% in noncommercial aircraft handled. The number of commuter aircraft handled increased by 9.4%; the number of air carrier aircraft handled increased by 3.9%; the number of general aviation aircraft handled declined by 1.2%; and the number of military aircraft handled declined by 13.2%.

Aircraft operations at the centers are expected to grow by an average of 2.3% a year between 1990 and 2000. In absolute numbers, center operations are forecast to increase from 36.6 million aircraft handled in 1989 to 47.8 million in 2000. In 1989, 47.9% of the traffic handled at centers were air carrier flights. This proportion is expected to increase only slightly to about 49.8% in 2000. In 1989, only 14.2% of the traffic handled were commuter operations. By the year 2002, approximately 20.0% of the centers' workload is expected to be generated by commuters. The projected annual growth rates by user groups over the forecast period are: air carrier, 2.4%; commuter/air taxi, 3.0%; and general aviation, 2.3%.

Instrument Flight Rules (IFR) operations increased at 15 of the 20 Continental United States (CONUS) ARTCCs over 1989.

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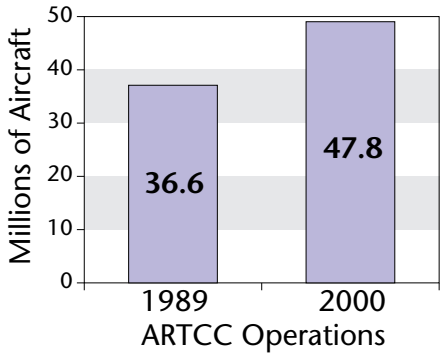

7. Figure 1-2 provides a map of the 20 CONUS ARTCCs. Figure 1-3 provides a comparison of the number of operations during FY89 versus the number of operations in FY90 at each of the 20 ARTCCs in CONUS. Figure 1-4 shows FY90 operations and a 10-year forecast.

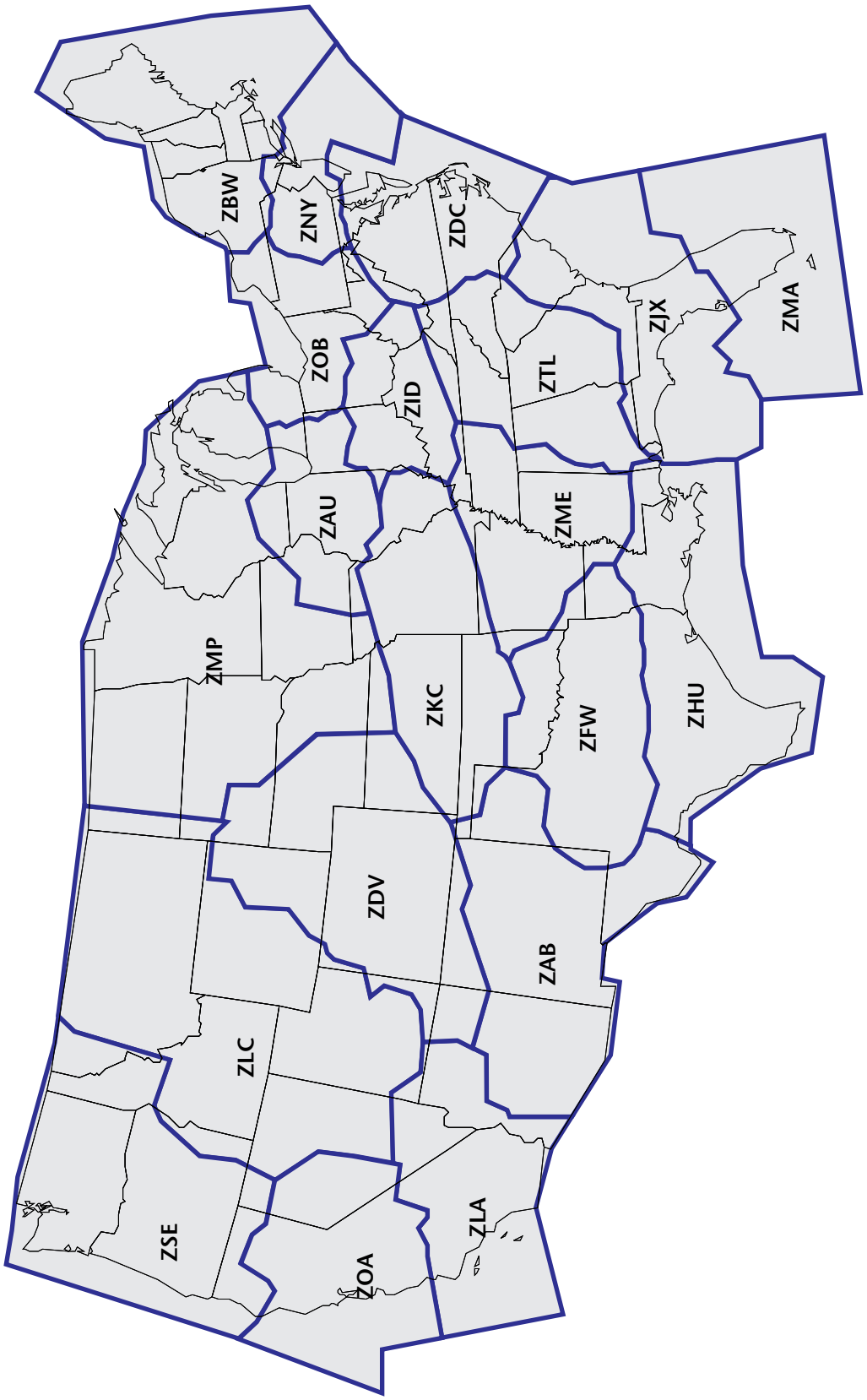

Figure 1-2. The 20 Continental U.S. Air Route Traffic Control Centers

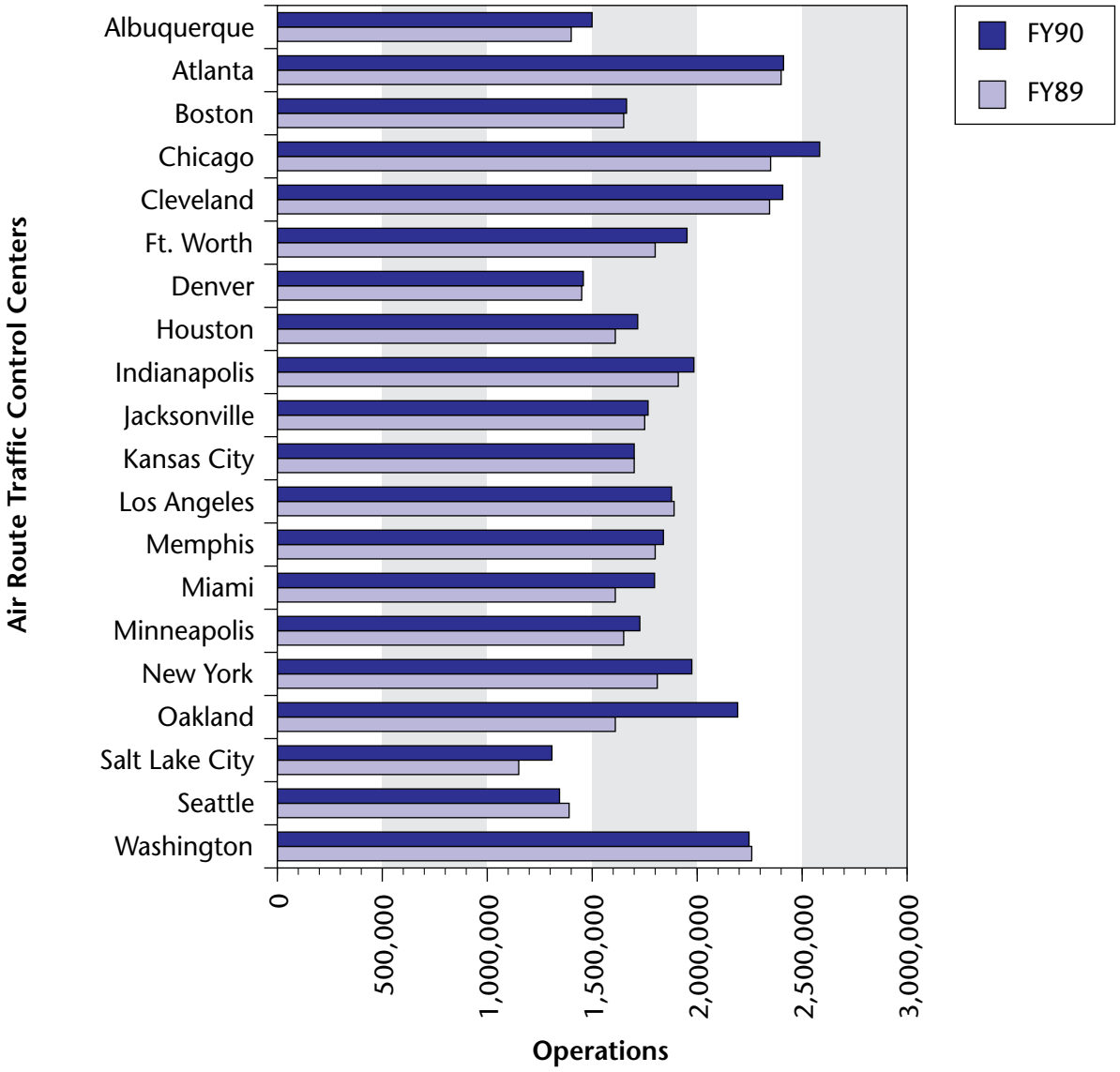

Figure 1-3. Operations at Air Route Traffic Control Centers
(Source: ATO-130 Air Traffic Activity and Delays Report, Sept. 1990)

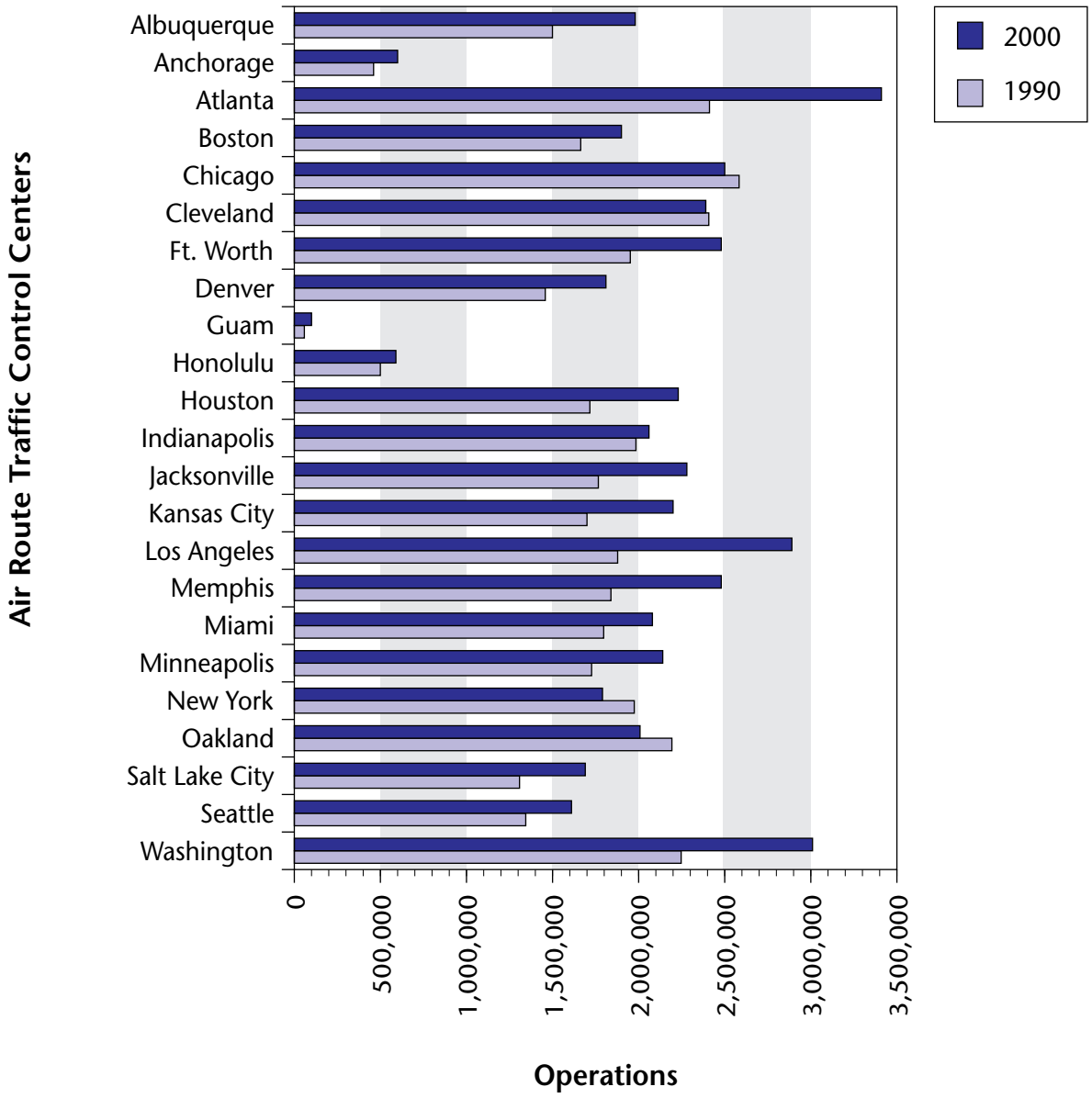

Figure 1-4. Air Route Traffic Control Center Forecasts
(Source: APO ARTCC Forecasts Fiscal Years 1990-2000, April 1991.)

The busiest Federal Aviation Administration (FAA) ARTCCs in 1989 were: Chicago, Cleveland, Atlanta, and Washington. Forecasts for 2000 indicate a change in ranking of the busiest ARTCCs to: Atlanta, Washington, Los Angeles, and Chicago.

Chicago Center, the busiest FAA ARTCC in 1989, handling 2.6 million aircraft, is projected to handle 3.4 million aircraft by the year 2000. Oakland Center is forecast to experience the largest absolute growth, from 1.7 million aircraft operations in 1989 to 2.5 million in the year 2000. This is attributable to the expected increase in airport hubbing activity in the western United States. The projected annual average growth rate of the Los Angeles Center over the period from 1989 to 2000 is significantly higher (3.4%) than the projected national rate of 2.3%. These growth rates reflect the increasing importance of the Pacific markets.

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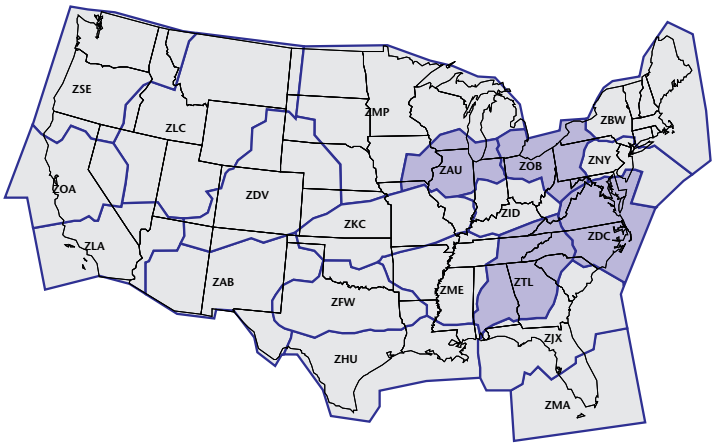
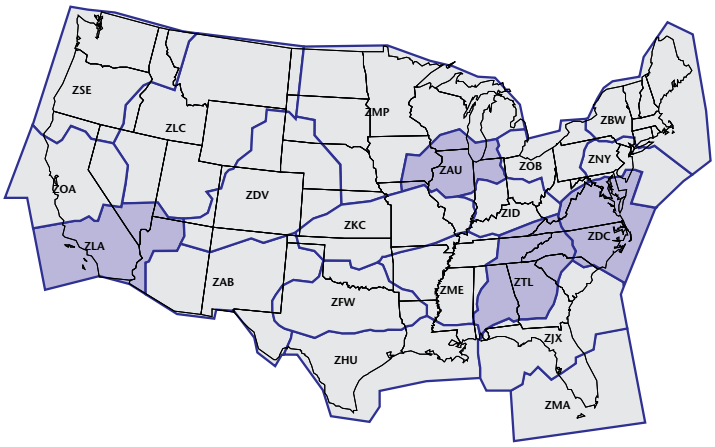
Busiest ARTCCs in 1989



Forecast Top ARTCCs in 1999



1.3 Delay [8]

1.3.1 Delay by Cause

Weather was attributed as the primary cause of 53% of operations delayed by 15 minutes or more in 1990, down from 57% in 1989.[9] Terminal air traffic volume accounted for a record 36% of delays greater than 15 minutes, (up from 29% in 1989), while air traffic center volume accounted for 2% of delays. Runway construction was the cause of 4% of delay in FY90, National Airspace System (NAS) equipment interruptions for 2%, and 3% was attributed to other causes.

Although flight delays exceeding 15 minutes were experienced on 404,367 flights in 1990, an increase of 3.3% over 1989, the total remains below the 1986 level of 418,000. In FY90, weather and terminal volume increased from 86% to 89% of total delays. Terminal volume was the primary cause of delay greater than 15 minutes 36% of the time in FY90, up from 29% the year before. With the exception of the split between terminal and center volume delays, the basic distribution of delay by cause has remained fairly consistent over the past six years.[10]

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8. Operations and enplanement data from the top 100 airports and the 20 CONUS ARTCCs presented in Section 1.1 are measures of airport and system activity. Delay can be thought of as another system performance parameter; as an indicator that capacity is perhaps being reached and even exceeded. Although no existing delay reporting system is fully comprehensive, this Plan aims to identify problem areas through available data, such as the following delay information and the previously mentioned aviation activity statistics.
9. See Figure 1-5 for the breakdown of FY89 and FY90 primary causes of delay.
10. See Table 1-1 for the 5-year history of this breakdown of delay by primary cause.

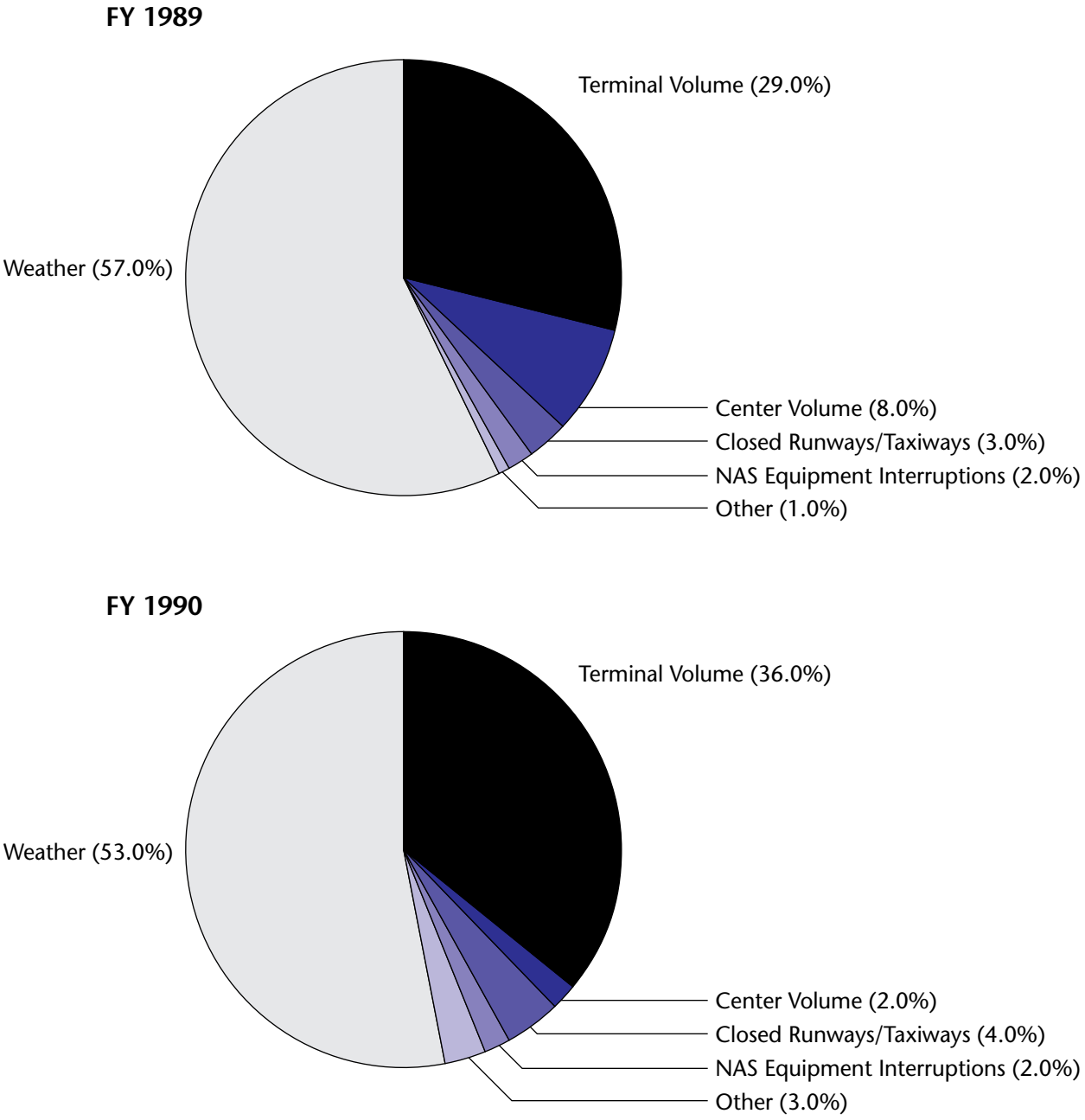

Figure 1-5. Primary Cause of Delay of 15 Minutes or More in FY89 and FY90

Source: Air Traffic Operations Management System (ATOMS) Data

Table 1-1. Distribution of Delay Greater Than 15 Minutes by Cause, 1984-1990

Distribution of Delay Greater than 15 Minutes by Cause						
Cause	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Weather	68%	67%	67%	70%	57%	53%
Terminal Volume	12%	16%	11%	9%	29%	36%
Center Volume	11%	10%	13%	12%	8%	2%
Closed Runways/Taxiways	6%	3%	4%	5%	3%	4%
NAS Equipment	2%	3%	4%	3%	2%	2%
Other	1%	1%	1%	1%	1%	3%
Total Operations Delayed (000s)	**334**	**418**	**325**	**322**	**392**	**404**
Percent Change from Previous Year	-17%	+25%	-22%	-1%	+21%	+3%

1.3.2 Delay by Phase of Flight [11]

Nearly 80% of all flights are delayed 1-14 minutes in taxi-in or taxi-out phases of flight. Only 5% of flights have any gate-hold delay. More delays occur during the taxi-out phase than any other phase.[12] However, since taxi-in delays have remained relatively constant at 2.1 to 2.3 minutes, it appears that the real bottleneck continues to be runway access for take-off.

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Taxi-in and taxi-out delay increased slightly from 1989 to 1990, while airborne delay remained about the same during the period.

11. The Airline Service Quality Performance (ASQP) data is collected, in general, from airlines with one-percent or more of the total domestic scheduled service passenger revenue. Airlines reporting as of July 1, 1991 include: Air West, Alaska, American, Continental, Delta, Midway, Northwest, Pan American, Southwest, TWA, United, and USAir. Actual departure time, flight duration, and arrival times are reported along with the differences between these and the equivalent data published in the *Official Airline Guide* (OAG) and entered in the Computer Reservation System (CRS).

    Taxi-in Delay: The difference between touchdown time and gate arrival time, minus a standard taxi-in time for a particular type of aircraft and airline at a specific airport.

    Taxi-out Delay: The difference between the time of lift-off and the time that the aircraft departed the gate, minus a standard taxi-out time established for a particular type of aircraft and airline at a specific airport.

    Airborne Delay: The difference between the time of lift-off from the origin airport and touchdown, minus the computer-generated optimum profile flight time for a particular flight, based on atmospheric conditions, aircraft loading, etc.

    Gate-hold Delay: The difference between the time that departure of an aircraft is authorized by ATC and the time that the aircraft would have left the gate area in the absence of an ATC gatehold.

    Mins./op: Average delay per operation.

12. Table 1-2 presents the percentage of operations delayed by 15 minutes or more.

To put this in perspective, there were 26 million operations in 1989. With an average airborne delay of 4.3 minutes per aircraft, this means that there was a total of over 1.8 million hours of delay, which, at an estimated $1,600 per hour, cost the airlines $2.9 billion.

Table 1-2. Percent of Operations Delayed

Percent of Operations Delayed 15 Minutes or More (Total ASQP System)[13]				
Year	1987	1988	1989	1990
Percent Delayed	8.0	8.6	9.7	10.3

Note: All delay measurements were obtained based on a 5th percentile for actual elapsed times for each city pair and air carrier.

Table 1-3. Average Delay by Phase of Flight

Average Delay by Phase of Flight (mins. per flight — total ASQP system)[13]				
Phase	**1987**	**1988**	**1989**	**1990**
Gate-hold	1.0	1.0	1.0	1.0
Taxi-out	6.6	6.8	7.0	7.2
Airborne	3.9	4.0	4.3	4.3
Taxi-in	2.1	2.1	2.2	2.3
Total	13.7	14.0	14.6	14.9
Mins./Op.	6.8	7.0	7.3	7.5

13. The Airline Service Quality Performance (ASQP) data is explained in footnote 11 on the previous page.

1.3.3 Identification of Forecast Delay-Problem Airports

In FY1990, the number of airline flight delays in excess of 15 minutes increased compared to 1989 at 14 of 22 major airports.[14] The percentage of flights delayed at these airports ranged from 0.1% of flights at Las Vegas to 9.7% at New York–La Guardia. The three top airports in delays exceeding 15 minutes were in the New York area.

In FY1990, the number of airline flight delays in excess of 15 minutes increased compared to 1989 at 14 of 22 major airports. The percentage of flights delayed at these airports ranged from 0.1% of flights at Las Vegas to 9.7% at New York–La Guardia.

Forecasts suggest that, in the absence of capacity improvements, delay in the system will continue to grow.[15] In 1990, 23 airports each exceeded 20,000 hours of airline flight delays. Assuming no improvements in airport capacity are made, 40 airports are forecast to each exceed 20,000 hours of airline flight delays by the year 2000. Figure 1-6 shows delays per 1,000 operations. Figure 1-7 shows the airports exceeding 20,000 hours of annual aircraft delay in 1990, while Figure 1-8 shows the airports exceeding 20,000 hours of annual aircraft delay in 2000, assuming there are no capacity improvements.

14. Figure 1-6. Delays Per 1,000 Operations.

15. Table 1-5. 1990 Actual and 2000 Forecast Air Carrier Delay Hours.

Table 1-4. Percentage of Operations Delayed 15 Minutes or More.

Airports	Percentage of Operations Delayed 15 Minutes or More				
	1986	1987	1988	1989	1990
New York La Guardia	8.9	6.5	5.2	9.6	9.7
Newark Intl.	13.8	6.5	6.7	10.6	8.8
New York Kennedy	7.0	6.5	5.3	6.1	7.7
Chicago O'Hare Intl.	5.6	4.6	5.5	10.3	6.9
San Francisco Intl.	5.3	6.2	6.3	7.1	5.7
Atlanta Hartsfield Intl.	6.5	6.2	3.5	2.5	3.9
Philadelphia Intl.	2.0	3.7	2.6	2.2	3.6
Boston Logan Intl.	7.3	4.8	3.7	2.9	3.3
Minneapolis Intl.	3.9	0.7	1.4	0.8	3.2
St. Louis-Lambert Intl.	4.4	1.6	2.7	2.9	2.8
Denver Stapleton Intl.	3.2	3.7	3.7	2.7	2.7
Dallas-Ft. Worth Intl.	2.6	2.0	1.4	2.4	2.7
Detroit Metropolitan	1.3	1.5	1.5	1.6	1.9
Houston Intl.	0.2	0.5	0.7	0.6	1.3
Washington National	3.2	2.3	1.5	1.0	1.2
Pittsburgh Intl.	0.6	0.7	0.7	0.8	0.9
Los Angeles Intl.	1.1	3.3	1.7	1.1	0.8
Miami Intl.	0.7	0.4	0.3	0.2	0.7
Cleveland Hopkins Intl.	0.3	0.1	0.5	0.3	0.5
Kansas City Intl.	1.0	0.5	0.2	0.3	0.3
Ft. Lauderdale Intl.	0.3	0.2	0.2	0.3	0.3
Las Vegas McCarran Intl.	0.0	0.1	0.1	0.2	0.1

Table 1-5. 1990 Actual and 2000 Forecast Air Carrier Delay Hours.

Annual Aircraft Delay in Excess of 20,000 Hours					
1990		2000			
Chicago O'Hare	ORD	Chicago O'Hare	ORD	Washington National	DCA
Atlanta Hartsfield	ATL	Dallas-Ft. Worth	DFW	Kansas City	MCI
Dallas-Ft. Worth	DFW	Atlanta Hartsfield	ATL	Cleveland	CLE
Los Angeles	LAX	San Francisco	SFO	Charlotte-Douglas	CLT
Newark	EWR	Washington Dulles	IAD	Cincinnati	CVG
San Francisco	SFO	Newark	EWR	Honolulu	HNL
Boston	BOS	St. Louis	STL	Houston	IAH
New York John F. Kennedy	JFK	Los Angeles	LAX	Las Vegas	LAS
St. Louis	STL	Phoenix	PHX	Windsor Locks	BDL
Phoenix	PHX	New York John F. Kennedy	JFK	Chicago Midway	MDW
Miami	MIA	Miami	MIA	Memphis	MEM
Philadelphia	PHL	Philadelphia	PHL	Baltimore Washington	BWI
Washington National	DCA	Boston	BOS	Ontario	ONT
Pittsburgh	PIT	Detroit	DTW	Ft. Lauderdale	FLL
Detroit	DTW	Pittsburgh	PIT	Raleigh-Durham	RDU
Orlando	MCO	New York La Guardia	LGA	San Jose	SJC
Minneapolis	MSP	Orlando	MCO	Seattle-Tacoma	SEA
Charlotte	CLT	Minneapolis	MSP	Dayton	DAY
Denver Stapleton	DEN	Salt Lake City	SLC	San Diego	SAN
Honolulu	HNL	Nashville	BNA	Tampa	TPA
Houston	IAH				
Seattle-Tacoma	SEA				
New York La Guardia	LGA				

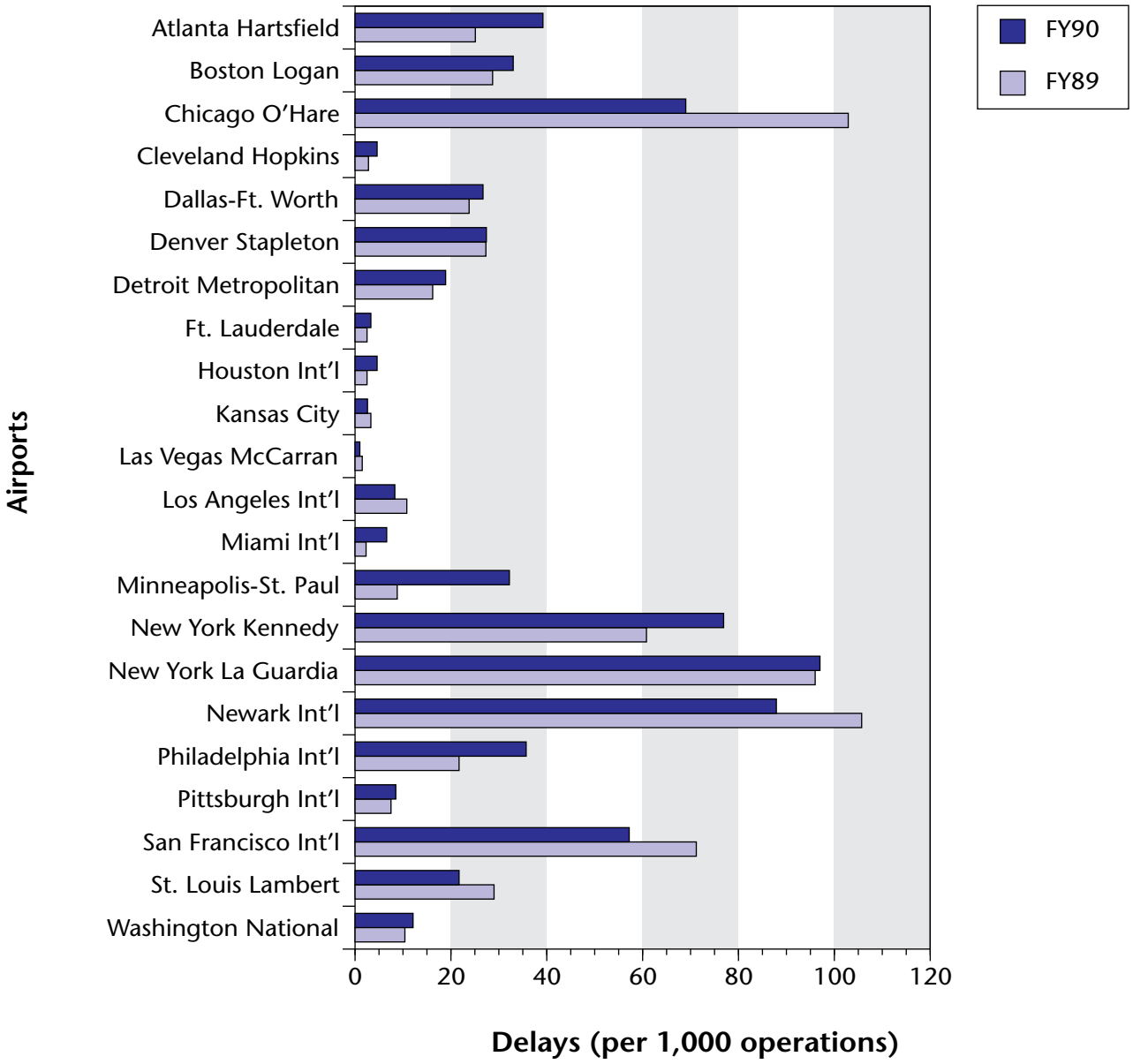

Figure 1-6. Delays Per 1,000 Operations
(Source: ATOMS Data)

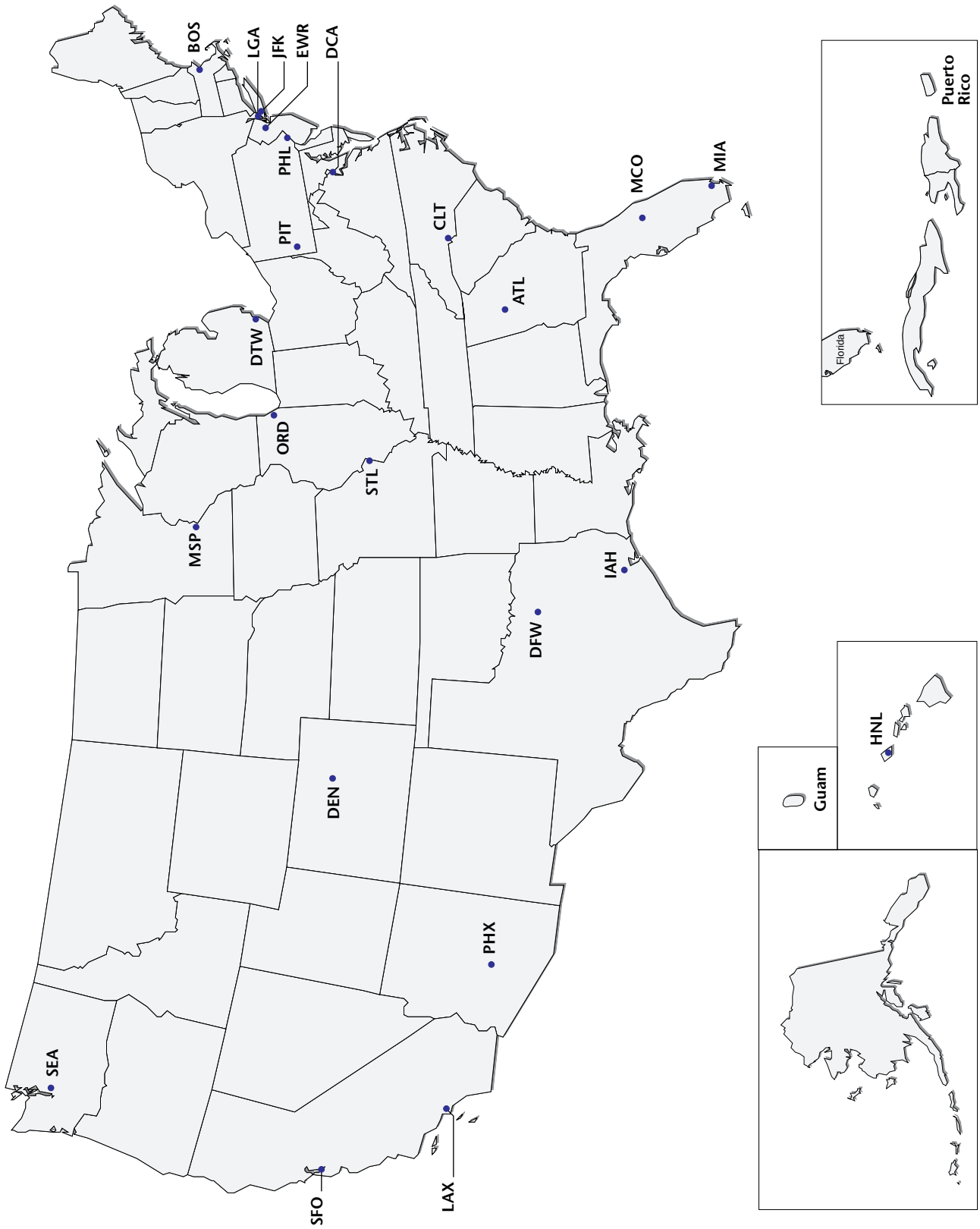

Figure 1-7. Airports Exceeding 20,000 Hours of Annual Aircraft Delay in 1990

Source: FAA Office of Policy and Plans

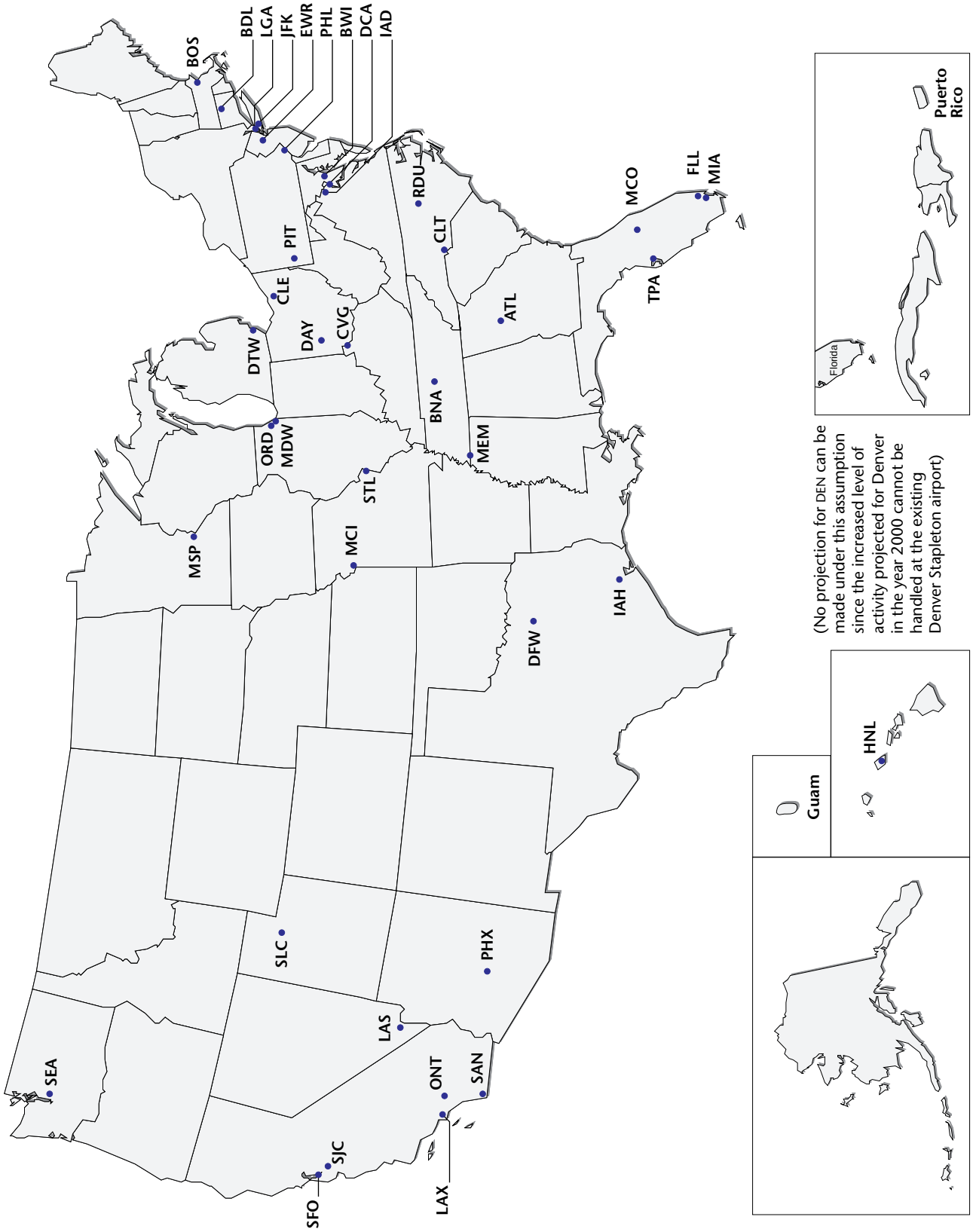

Figure 1-8. Airports Exceeding 20,000 Hours of Annual Aircraft Delay in 2000, Assuming No Capacity Improvements

Source: FAA Office of Policy and Plans